REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejection and further examination are respectfully requested.

The specification and abstract have been reviewed and revised to improve their English grammar. The amendments to the specification and abstract have been incorporated into a substitute specification and abstract. Attached are two versions of the substitute specification, a marked-up version showing the revisions, as well as a clean version. No new matter has been added.

Original claims 1-7 have been cancelled without prejudice or disclaimer of the subject matter contained therein and replaced by new claims 8-12. The new claims have been drafted to further distinguish the present invention from the reference relied upon in the rejections discussed below.

Claims 1-7 were rejected under 35 U.S.C. § 102(b) as being anticipated by Synergetics, Inc (WO 97/34293). This rejection is believed clearly inapplicable to new claims 8-12 for the following reasons.

New independent claim 8 recites a sensitivity enhancement apparatus including a voice cutout apparatus. According to claim 8, the voice cutout apparatus (1) is capable of cutting out a phoneme unit of selected digital voice data, and includes a section for (2) providing a cutout start moment and a cutout end moment, according to which the cutout apparatus cuts out the phoneme unit, and for providing an offset value less than or equal to one phoneme. Further, claims 8 recites that, (3) when the cutout end moment is located at a middle of a phoneme, the voice data cutout apparatus is operable to shift the cutout end moment to the end of the phoneme by shifting the cutout end moment by the offset value, and (4) when the cutout start moment is located at a middle of a phoneme, the voice data cutout apparatus is operable to shift the cutout start moment to a beginning of the phoneme by shifting the cutout start moment by the offset value.

This above-mentioned configuration results in a phoneme unit cut out from selected digital voice data, wherein the phoneme unit contains digital voice data that can be used for theoretical voice diagnosis because of the above-mentioned shifting by the offset value. By providing digital voice data that can be used for voice diagnosis, there is no need for a voice diagnosis device to extract and analyze the voice data to determine

whether or not the digital voice data includes useful information (i.e., voice data that can be analyzed rather than silence). Synergetics fails to disclose or suggest the above-mentioned distinguishing features (1)-(4) and the resulting benefit, as recited in claim 8.

Rather, Synergetics teaches that data is broken-up into successive "time segments," wherein each time segment is a set length (see page 11, lines 8 and 9), and teaches that each time segment is sliced into successive "time slices," wherein each time slice is also a set length (see page 11, lines 12 and 13). Finally, Synergetics teaches that sound characteristics of a time slice are extracted for determining whether the extracted sound is quiet, voiced, or unvoiced (see page 11, lines 13, 14, and 17-19).

Thus, in view of the above, it is clear Synergetics teaches that sound characteristics from a time slice having a set length are extracted and then analyzed, but does not disclose or suggest the use of a cutout start moment, a cutout end moment, and an offset value less than or equal to one phoneme, as required by claim 8. In other words, Synergetics discloses extracting and analyzing data from a set length of data, which is not a disclosure or suggestion of a voice data output apparatus which can shift the start moment or the end moment by the offset value that is less than or equal to one phoneme, as recited in claim 8.

Specifically, it is evident that Synergetics does not disclose or suggest that, when the start moment is located at a beginning of a phoneme and the cutout end moment is located at a middle of a phoneme, the voice data cutout apparatus shifts the cutout end moment to an end of the phoneme by shifting the cutout end moment by the offset value, and when the cutout start moment is located at a middle of a phoneme and the cutout end moment is located at an end of a phoneme, the voice data cutout apparatus shifts the cutout start moment to a beginning of the phoneme by shifting the cutout start moment by the offset value, as required by claim 8.

Moreover, as mentioned above, the invention of claim 8 results in digital voice data that is useful for voice diagnosis because is no need for a voice diagnosis device to extract and analyze the voice data to determine whether or not the voice data includes useful information. However, it is clear that the invention of Synergetics does not result in the above-mentioned benefit, since Synergetics teaches that the voice data from each time slice is analyzed to determine whether the voice data is quiet, voiced, or unvoiced.

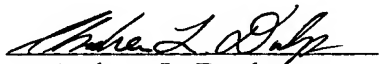
Therefore, for the reasons discussed above, Synergetics does not anticipate independent claim 8.

Furthermore, there is no disclosure or suggestion in Synergetics or elsewhere in the prior art of record which would have caused a person of ordinary skill in the art to modify Synergetics to obtain the invention of independent claim 8. Accordingly, it is respectfully submitted that independent claim 8 and claims 9-12 which depend therefrom are clearly allowable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance and an early notification thereof is earnestly requested. The Examiner is invited to contact the undersigned by telephone to resolve any remaining issues.

Respectfully submitted,

Kakuichi SHIOMI et al.

By: 

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December 18, 2007

Version with Markings to Show Changes Made

DESCRIPTION

SENSITIVITY ENHANCEMENT APPARATUS FOR CHAOS THEORETICAL DIAGNOSIS

BACKGROUND OF THE INVENTION

1. ~~TECHNICAL~~ FIELD OF THE INVENTION

The present invention relates to a preprocessing apparatus connected to an apparatus for diagnosing a psychosomatic state ~~on the basis~~ of ~~uttered~~ a voice uttered by a human being, an apparatus for diagnosing the brain function, an apparatus for diagnosing a human factor, an apparatus for diagnosing affinity, an apparatus for diagnosing a vocational aptitude, and so on. The present invention belongs to the field of the medical diagnosis technique.

2. BACKGROUND OF THE RELATED ART

In ~~the~~ a conventional chaos theoretical diagnosis system or apparatus using uttered voice, a numerical value is used as a diagnosis subject data. This numeric value can be obtained by mechanically dividing a continuous uttered voice into specific processing unit time intervals, such as voice signals each having a temporal length of one second, calculating the first Lyapunov exponent in each processing unit time interval, and conducting

statistical processing such as moving average calculation on the calculated first Lyapunov exponent. ~~is used as diagnosis subject data.~~

If voice data of the processing unit time interval to be used in the chaos theoretical diagnosis is mechanically cut out from an input voice, then a subtle difference in a cutout point in time exerts influence upon the calculated first Lyapunov exponent and causes variation in the diagnosis value.

For reducing the variation in the diagnosis value, it is necessary to set a time that is sufficiently long as compared with the cut out time. For example, ~~for example, set~~ by setting an average time in the range of several tens of seconds to several minutes in the case where the processing unit time is set equal to one second. It is also necessary to~~,~~ calculate a temporal average value from the first Lyapunov exponent calculated in respective processing units, and use the temporal average value as a diagnosis value.

When making a chaos theoretical diagnosis from the uttered voice, for example, a continuous uttered voice ranging over at least several minutes is needed as input data in order to get a high diagnosis precision, such as to reduce an error in diagnosis value to several percents or less.

In addition, in the conventional voice signal processing method, it has been impossible to make a significant diagnosis

by using a voice signal taken for an interval of approximately several times as long as the processing unit time, such as a voice signal taken for several seconds in the case where the processing unit time interval is one second.

Even if the processing unit time is made shorter, merely the number of the first Lyapunov exponent that must be calculated increases. For example, if the processing unit time is shortened from one second to 0.1 second, the number of the first Lyapunov exponent that must be calculated increases to ten times. Even if a time interval as long as ten times or more is spent for computation processing, the variation in Lyapunov exponent caused by deviation in a point in time, at which each diagnosis data is cut out, can not be effectively reduced. It is impossible to make a significant diagnosis by using a voice taken for an interval of several seconds.

In the conventional technique ~~heretofore~~ described above, it has become an important problem to clarify a method for reducing the variation in the calculated first Lyapunov exponent caused by a difference in a point of time at which diagnosis data is cut out from voice data used in the chaos theoretical diagnosis. Furthermore, a method for calculating a comparatively highly reliable diagnosis value from comparatively short voice data has become an important problem in the same way.

The present invention has been ~~achieved in order~~ developed

to solve the above-described problems. An object of the present invention is to provide an apparatus that reduces the variation in the first Lyapunov exponent calculated using a chaos theoretical diagnosis by cutting out unit voice data used in the chaos theoretical diagnosis while taking a phoneme as the unit, and that calculates a diagnosis value having a reliability equal to or higher than that obtained by using the conventional technique, on the basis of voice data shorter than that in the case using the conventional technique.

~~DISCLOSURE~~ SUMMARY OF THE INVENTION

In order to achieve these objects, the invention according to a first aspect provides a sensitivity enhancement apparatus of chaos theoretical diagnosis that is a preprocessing apparatus connected to a chaos theoretical voice diagnosis apparatus for analyzing an uttered voice ~~uttered by an utterer~~ by using a chaos theory technique, calculating a Lyapunov exponent, and measuring and evaluating a change state of the calculated Lyapunov exponent. The sensitivity enhancement apparatus includes: ~~, comprising:~~ a voice input apparatus for acquiring the uttered voice; an analog-digital conversion apparatus for converting the uttered voice acquired by the voice input apparatus to digital voice data; a comparator for selecting voice data having a level which is equal to at least a certain input level, from the digital

voice data output from the analog-digital conversion apparatus, and for ~~and~~ outputting the voice data thus selected; a voice data cutout apparatus capable of cutting out voice data having a level which is equal to at least a certain input level output from the comparator, while taking a phoneme as a unit; and a voice data output apparatus for outputting voice data of phoneme unit output from the voice data cutout apparatus.

As a result, unit voice data cut out in a phoneme or phoneme sequence form can be output to the chaos theoretical diagnosis apparatus as diagnosis data. Therefore, the variation in the first Lyapunov exponent calculated by using the chaos theoretical diagnosis can be remarkably reduced.

In accordance with a second aspect of the invention, in addition to the configuration according to the first aspect, an internal memory for recording the voice data output from the comparator, a phoneme database for storing phoneme data to be collated with the voice data recorded in the internal memory, and a phoneme collation apparatus for cutting out and outputting only a phoneme that coincides with the phoneme data in the phoneme database are connected between the comparator and the voice data cutout apparatus.

As a result, in addition to the effect of the first aspect, it is possible to grasp the psychosomatic state, brain function, human factor, affinity, and vocational aptitude more accurately,

by limiting phoneme data stored in the phoneme database to phoneme data of a specific utterer.

In accordance with a third aspect of the invention, in addition to the configuration according to the first aspect, an internal memory for storing the voice data output from the comparator, a phoneme sequence database for storing phoneme sequence data to be collated with the voice data stored in the internal memory, and a phoneme sequence collation apparatus for cutting out and outputting only a phoneme sequence that coincides with the phoneme sequence data in the phoneme sequence database, are all connected between the comparator and the voice data cutout apparatus.

As a result, in addition to the effect of the first aspect, it is possible to grasp the psychosomatic state, brain function, human factor, affinity, and vocational aptitude more accurately, by limiting phoneme sequence data stored in the phoneme sequence database to phoneme sequence data of a specific utterer.

In accordance with a fourth aspect of the invention, in addition to the configuration according to the first aspect, the voice data cutout apparatus starts voice data cutout from the voice data stored in the internal memory at a moment an utterance of a preset vowel or consonant is started, and finishes the voice data cutout at a moment an utterance of at least one phoneme is finished, and thereby cut outs unit voice data formed

of a phoneme or a phoneme sequence.

As a result, in addition to the effect of the first aspect, voice data of one phoneme or more, from the moment the utterance of a vowel or consonant is started, is cut out. ~~, and consequently~~ Consequently, it becomes possible to output more accurate diagnosis data while taking a phoneme as the unit.

In accordance with a fifth aspect of the invention, in addition to the configuration according to the first aspect, the voice data cutout apparatus includes a phoneme discrimination section for arbitrarily selecting and setting a phoneme or phoneme sequence, and cuts out unit voice data formed of a phoneme or a phoneme sequence that coincides with a specific phoneme or a phoneme sequence set by the phoneme discrimination section, from the voice data stored in the internal memory.

As a result, in addition to the effect of the first aspect, a phoneme sequence arranged regularly such as a daily used phrase can be set to unit voice data, and consequently it becomes possible to eliminate an error caused by a mixed presence of a plurality of irregular phonemes. Therefore, diagnosis data required to obtain a diagnosis value having reproducibility can be obtained in a minute.

In accordance with a sixth aspect of the invention, in addition to the configuration according to the fourth or fifth aspect, the voice data cutout apparatus includes offset providing

means capable of providing a cutout start moment and a cutout end moment with an offset value equal to one phoneme or less, and when cutting out unit voice data formed of a phoneme or a phoneme sequence from the voice data stored in the internal memory, the cutout start moment and the cutout end moment can be adjusted by the offset providing means.

As a result, in addition to the effect of the fourth or fifth aspect, it becomes possible to correct an apparatus error by conducting fine adjustment of one phoneme or less and it is ensured to provide more accurate diagnosis data.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a system configuration diagram showing an example of a system configuration of a preprocessing apparatus according to an embodiment of the present invention.

FIG. 2 is a flow chart showing an example of a process flow of a preprocessing apparatus according to the embodiment of the present invention.

FIG. 3 is a diagram showing a concept of acquiring a phoneme and an utterance time from voice data in a preprocessing apparatus according to the embodiment of the present invention.

FIG. 4 is a diagram showing a conventional concept of acquiring a phoneme and an utterance time from voice data.

FIG. 5 is a diagram showing a concept of acquiring a phoneme

and an utterance time from voice data in a preprocessing apparatus according to the embodiment of the present invention.

~~BEST MODE FOR CARRYING OUT~~DETAILED DESCRIPTION OF THE INVENTION

Hereafter, an embodiment of the present invention will be described with reference to the drawings.

FIGS. 1 to 5 show embodiments of the present invention.

FIG. 1 is a schematic diagram showing a system configuration example of a preprocessing apparatus for chaos theoretical diagnosis according to an embodiment of the present invention.

In FIG. 1, a preprocessing apparatus 1 for chaos theoretical diagnosis (hereafter referred to as "invention apparatus") includes a voice input apparatus 2, an analog-digital conversion apparatus 3, a comparator 4, an internal memory 5, a phoneme collation apparatus 6, a phoneme sequence collation apparatus 7, a phoneme database 8, a dictionary database 9, a voice data cutout apparatus ~~10~~11 and a voice data output apparatus ~~11~~10.

The voice input apparatus 2 is a microphone or a tape recorder for acquiring uttered voice of an utterer as analog voice.

The analog-digital conversion apparatus 3 is an apparatus for sampling and quantizing analog voice acquired by the voice

input apparatus 2 at a constant sampling frequency and thereby converting the analog voice to digital voice data.

The comparator 4 selects voice data having a level which is equal to or higher than a certain input level, from the digital voice data output from the analog-digital conversion apparatus 3, and outputs the voice data thus selected.

The internal memory 5 is an internal storage apparatus for buffering the voice data output from the comparator 4. The internal memory 5 has a capacity sufficient for the invention apparatus.

The phoneme collation apparatus 6 collates the voice data buffered in the internal memory 5 with a phoneme database 8, which stores phoneme data for each phoneme, and outputs a coincident phoneme as unit phoneme data.

The phoneme sequence collation apparatus 7 collates the voice data as a phoneme sequence, if there are a plurality of phonemes in the voice data, with the dictionary database 9, which stores word dictionary for each phoneme sequence, and outputs a coincident phoneme sequence, and a phoneme sequence width ranging from a voice data start moment to a voice data end moment of the coincident phoneme sequence as second processing data.

The voice data cutout apparatus 11 is an apparatus for acquiring a phoneme or a phoneme sequence as unit voice data. The phoneme or a phoneme sequence is cut out from the internal

memory 5 as coincident one and output from the phoneme collation apparatus 6 and the phoneme sequence collation apparatus 7.

The voice data cutout apparatus 11 includes a phoneme discrimination section 12 capable of selecting and setting a phoneme, a phrase to be used in daily conversation, or a phoneme sequence formed of a combination of arbitrary phonemes as unit voice data.

The voice data output apparatus 10 outputs unit voice data as diagnosis data acquired from the internal memory 5 by the voice data cutout apparatus 11. The unit voice data are given to a chaos theoretical diagnosis apparatus following the invention apparatus.

FIG. 2 is a flow chart showing a process flow in the invention apparatus.

~~Voice~~ An uttered voice ~~by an utterer~~ is acquired as an analog voice by using the voice input apparatus 2 (S100).

In the analog-digital conversion apparatus 3, the voice acquired from the voice input apparatus 2 is sampled and quantized at a constant sampling frequency, and the analog voice is thus converted to digital voice data (S110).

The digital voice data output from the analog-digital conversion apparatus 3 is supplied to the comparator 4 (S120), and only voice data having an input level which is equal to or higher than a certain input level is acquired (S130) and buffered

in the internal memory 5 (S140). If the voice data is less than the constant input level, then the voice data is returned to the comparator 4 and the processing is repeated.

If the buffered volume has become at least a certain volume (S150), then voice data in the internal memory 5 is collated in the phoneme collation apparatus with phoneme data stored in the phoneme database 8 (S160). If the buffered volume is less than the certain volume, then the processing is returned to the comparator 4 and repeated.

If there is a phoneme that coincides with a phoneme in the internal memory 5 in the phoneme database 8 (S170), then the phoneme is output from the internal memory 5 (S180). If there is not a coincident phoneme, then the processing is returned to the comparator 4 and repeated.

If there are a plurality of phonemes, then voice data regarded as a phoneme sequence is collated in the phoneme sequence collation apparatus with word dictionary data stored in the dictionary database 9 (S190).

If there is a phoneme sequence that is coincident with a phoneme sequence stored in the dictionary database 9, then a range between a moment at which utterance of the coincident phoneme sequence is started and a moment at which the utterance is finished is set as a cutout range, and a phoneme sequence contained in the range is output (S200).

In the phoneme discrimination section 12 in the voice data cutout apparatus 11, a diagnosing person arbitrarily selects a phoneme or a phoneme sequence to be used as diagnosis data, in advance (S210).

If a phoneme or a phoneme sequence output from the phoneme collation apparatus 6 or the phoneme sequence collation apparatus 7 coincides the arbitrarily selected phoneme or phoneme sequence (S220), then the voice data cutout apparatus 11 cuts out the coincident phoneme or phoneme sequence as unit voice data from the internal memory 5 (S230). If there is no coincident phoneme or phoneme sequence, then the processing is returned to the comparator 4 and repeated.

The voice data output apparatus 10 acquires this unit voice data and outputs the unit voice data to the chaos theoretical diagnosis apparatus following the invention apparatus as diagnosis data (S240).

Means shown in the embodiment are only divided logically in function, but they may form the same region physically or substantially.

A difference between the invention apparatus and the conventional method is shown in FIGS. 3 and 4.

FIG. 3 is a diagram showing the concept of outputting a phoneme and utterance time on the basis of voice data in the method of the invention apparatus.

For example, when uttered voice data for outputting diagnosis data to be used in the chaos theoretical diagnosis is in the range of A110 to A130. The cutout start moment of diagnosis data is set to A110 where the utterance of an /o/ sound is not yet started. The cutout end moment of the diagnosis data is set to A120 where the utterance of a /yo/ sound has been finished. Accordingly, it becomes possible to output voice data ranging from A110 to A120 in the form of a phoneme or phoneme sequence as diagnosis data without being cut in the middle of a phoneme.

As a result, voice data can be output as diagnosis data in the form of a phoneme or phoneme sequence without being cut in the middle of a phoneme. Therefore, it also becomes possible to decrease the variation in diagnosis values, which exert influence on the value of the first Lyapunov exponent calculated by making a chaos theoretical diagnosis.

FIG. 4 is a diagram showing the concept of outputting a phoneme and utterance time on the basis of voice data in the conventional method.

For example, when voice data of an utterer for calculating diagnosis data to be used in the chaos theoretical diagnosis is in the range of B110 to B130. In the case where the time intervals to be processed of diagnosis data to be used in the chaos theoretical diagnosis is one second, the cutout start moment of diagnosis data is set to B110 and the cutout end moment

of the diagnosis data is set to B120, which ~~that~~ is a moment one second later than B110. Under these conditions, data between B110 and B120 is output as diagnosis data, and there is a possibility that the diagnosis data will be cut in the middle of a phoneme.

As a result, there is a possibility that the diagnosis data will be cut in the middle of a phoneme. Therefore, the variation occurs in diagnosis values, which exert influence on the value of the first Lyapunov exponent calculated by making a chaos theoretical diagnosis.

FIG. 5 is a diagram showing the concept of setting an offset when cutting out a phoneme in the invention apparatus.

For example, it is supposed that voice data of an utterer for outputting diagnosis data to be used in the chaos theoretical diagnosis is in the range of C110 to C170. The cutout start moment is set to C110 and the cutout end moment is set to C120. In order to prevent a phoneme from being cut in the middle of the phoneme, an offset value equal to or less than one phoneme is set for the cutout end moment C120 by offset providing means. Thus, the cutout end moment is shifted to C130, being able to prevent a phoneme from being cut in the middle of the phoneme.

Furthermore, when the cutout start moment is set to C150 and the cutout end moment is set to C160, and an offset value equal to or less than one phoneme is set for the cutout start

moment C150 as a minus value by offset providing means. Thus, the cutout start moment is shifted to C140, being able to output diagnosis data containing voice data uttered before the diagnosis data.

INDUSTRIAL APPLICABILITY

The present invention relates to a preprocessing apparatus, which belongs to the field of ~~the~~ medical diagnosis techniques, connected to an apparatus for diagnosing a psychosomatic state on the basis of ~~uttered~~ a voice uttered by a human being, an apparatus for diagnosing ~~the~~ a brain function, an apparatus for diagnosing a human factor, an apparatus for diagnosing affinity, and an apparatus for diagnosing a vocational aptitude. The present invention provides an industrially useful apparatus capable of reducing the variation in the first Lyapunov exponent calculated using a chaos theoretical diagnosis by cutting out unit voice data used in the chaos theoretical diagnosis while taking a phoneme as the unit, and capable of calculating a diagnosis value having a reliability equal to or higher than that obtained by using the conventional technique, on the basis of voice data shorter than that in the case using the conventional technique.

ABSTRACT

~~A~~ The present invention is a preprocessing apparatus ~~includes~~ including a voice input apparatus ~~2~~ for acquiring an uttered voice~~;~~, an analog-digital conversion apparatus ~~3~~ for converting the acquired uttered voice ~~acquired by the voice input apparatus 2~~ to digital voice data~~;~~, and a comparator ~~4~~ for selecting voice data, having a level which is equal to or higher than a certain level, from the digital voice data ~~output from the analog-digital conversion apparatus 3~~ and for outputting the selected voice data. The preprocessing apparatus also includes ~~thus selected;~~ a voice data cutout apparatus ~~11~~ capable of cutting out voice data having a level which is equal to or higher than a certain level output from the comparator ~~4~~, while taking a phoneme as a unit~~;~~, and a voice data output apparatus ~~10~~ for outputting voice data of the phoneme unit output from the voice data cutout apparatus ~~11~~.